Rapid Synthesis and Simulation Tools Element

Industry/Academia Workshop

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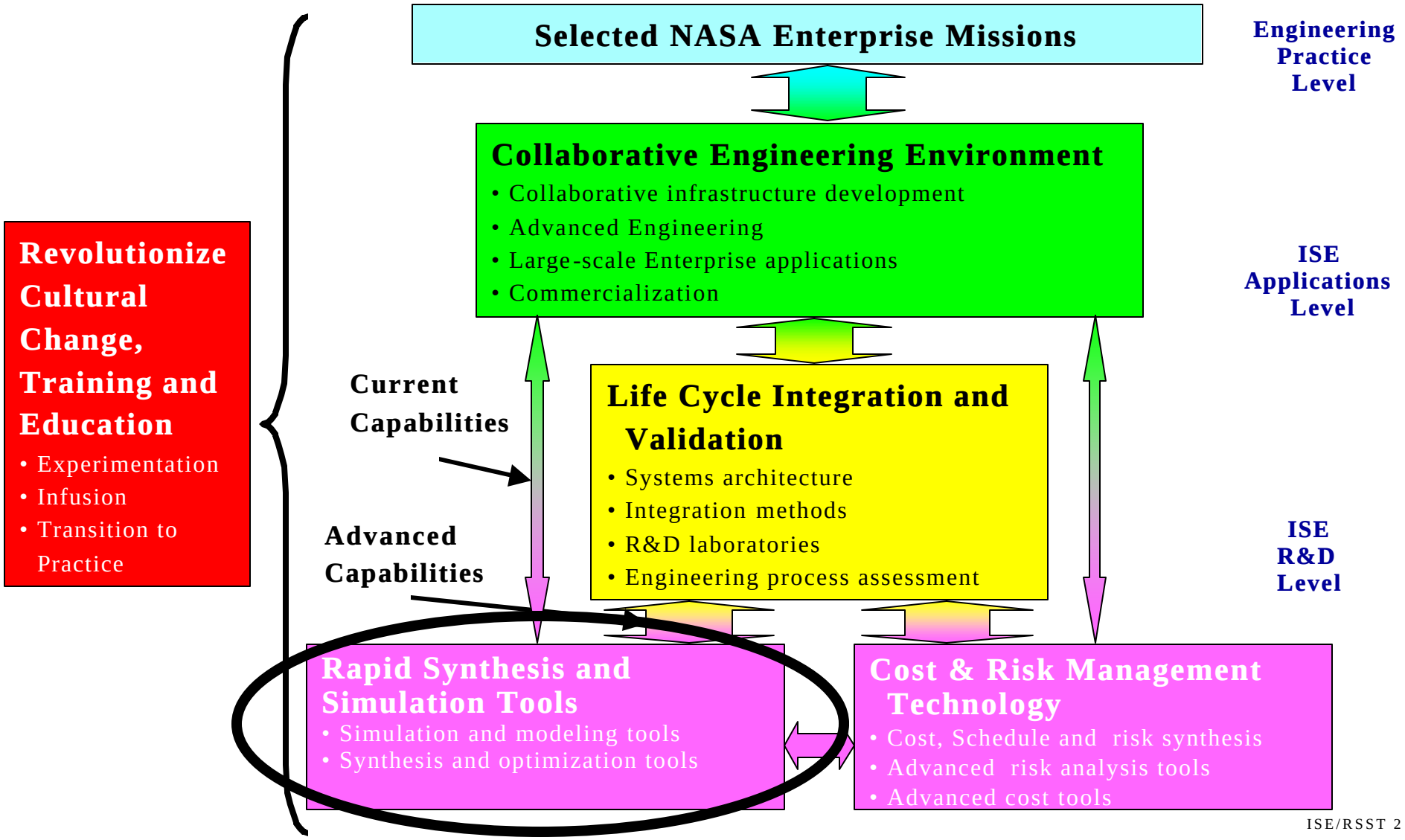
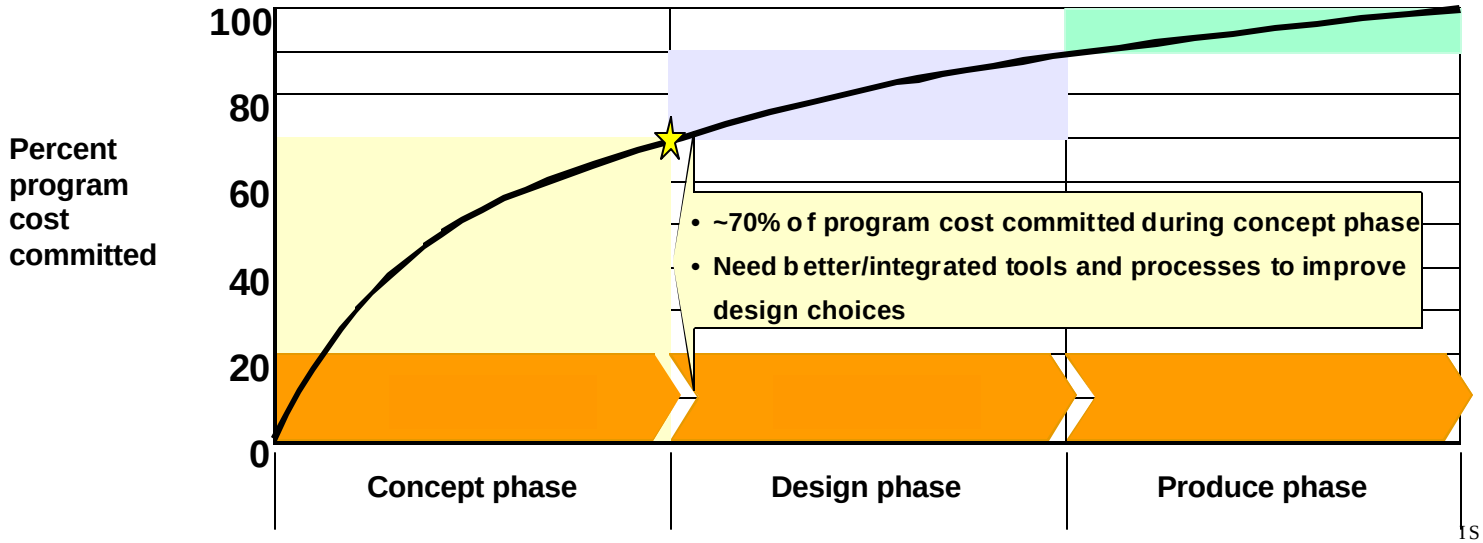
Rapid Synthesis and Simulation Tools

Intelligent Synthesis Environment Industry/Academia Workshop



Problem Statement

- Current design process is requirements driven
- Capability to analyze full life-cycle does not exist
- Lack of integrated high-fidelity tools
- Lack of uncertainty analysis within the design process
- Current modeling of complex designs takes months
- Engineers spend time interacting with computer software at the expense of spending time on the design



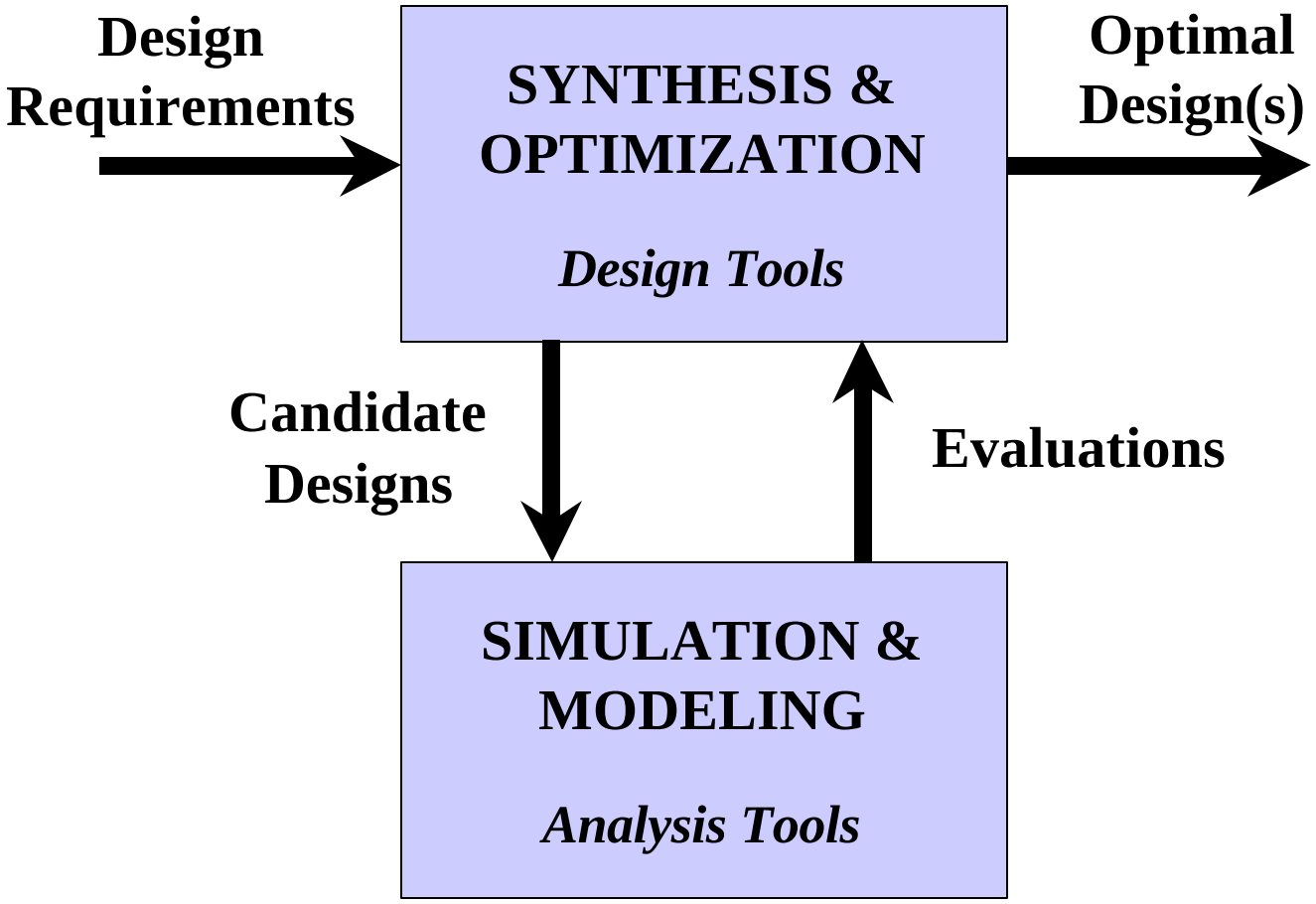
Goal

Develop and validate revolutionary engineering and science tools for synthesis and simulation of systems from concept through disposal to foster engineering creativity and productivity.

Objectives

- Demonstrate a reduction in design & mission development time/cycle
- Demonstrate a reduction in mission failures and anomaly rates
- Demonstrate a reduction in life cycle costs

Approach


Design Requirements
SYNTHESIS & OPTIMIZATION
Design Tools
Optimal Design(s)
Candidate Designs
Evaluations
SIMULATION & MODELING
Analysis Tools

5-Year Deliverables

- **Document of baselined capabilities, technology gaps, and high-payoff tool development opportunities (3Q00)**

- **Provide executable code with documentation describing tool verification process, software specifications and usage practices for**
  - Near-term tools (2Q01)
  - Non-deterministic tools (4Q01)
  - Advanced tools, specifically describe practices for integration with CRMT (3Q02)
  - Generic simulation capability (1Q03)
  - Multidisciplinary system optimization capability (4Q03)
  - Advanced tools capable of simulating the full life cycle (4Q04)

Technology Transition

Near term technology

- **Technology to provide stop-gap measures for current CEE capability will be provided directly to CEE**

Longer range technology

- **Tools developed incorporating current non-traditional techniques will be provided to LCIV for integration**
- **Revolutionary technologies will be investigated, as capability and payoff is determined, tools will be developed and provided to LCIV for integration**

NASA/Industry/Academia/OGA Roles

- As NASA hardware supplier, industry will be involved in all phases of advanced synthesis development, i.e., requirements definition, implementation, evaluation, etc.

- Industry involved in lower-risk tool development
  - Based on organizational needs
  - RSST enables path for industry tools to be integrable with RSST practices

- Academia and NASA will research advanced, revolutionary techniques/methods

- NASA synthesis activities will be coordinated with current and future OGA activities to provide maximum resource leverage

Modeling Tools

- **Description** - An algorithm and input data that convert the input to an output which provides insight into WHAT will happen (example - discipline tools)
- **Current SOA**
  - Tools are physics based
  - Majority are deterministic
  - Tools developed independently to meet organizational need
  - Tools not rapid enough for integration into a near-real-time system
  - No common data protocols/standards for tool input/output
- **RSST Enabled Future Capability**
  - Incorporate uncertainty modeling to enable assessment of ability to achieve the design (consider non-deterministic methods, fuzzy logic)
  - Incorporate promising non-traditional techniques identified as means to achieve faster solution times (consider neural nets, wavelets)
  - Common data protocols allowing data transfer between tools

Simulation Tools

- **Description** - The time-based execution of one or more models (example - virtual manufacturing)
- **Current SOA**
  - Tools are low fidelity, not highly accurate
  - Majority are deterministic
  - Tools are computationally intensive
  - Visualization is archaic
  - Multi-model synchronization & data interchange difficult
- **RSST Enabled Future Capability**
  - Develop technologies for simulating all aspects of a life-cycle (particularly add manufacturing and operation simulations)
  - Enhance level of fidelity and reduce computation time to enable preliminary simulation-in-the-loop design processes
  - Develop technologies for high-fidelity visualization of simulation
  - Develop technologies for model reuse and rapid integration of models for large-scale distributed simulations, including hardware-in-the-loop simulations

Synthesis Tools

- **Description** - Combining a set of pieces for the purpose of creating a whole that serves a certain purpose

- **Current SOA**
  - Manual process requiring a human expert in the loop to make decisions

- **RSST Enabled Future Capability**
  - Develop a rudimentary design space exploration tool to provide designers a user-friendly design and mission manipulation capability (consider bio-semiotics, intelligent assistants)
  - Develop libraries of component geometry & behavioral models that include meta-data to facilitate reuse and parameterization; develop intelligent agents to peruse model libraries and select optimal system components given user specified constraints.

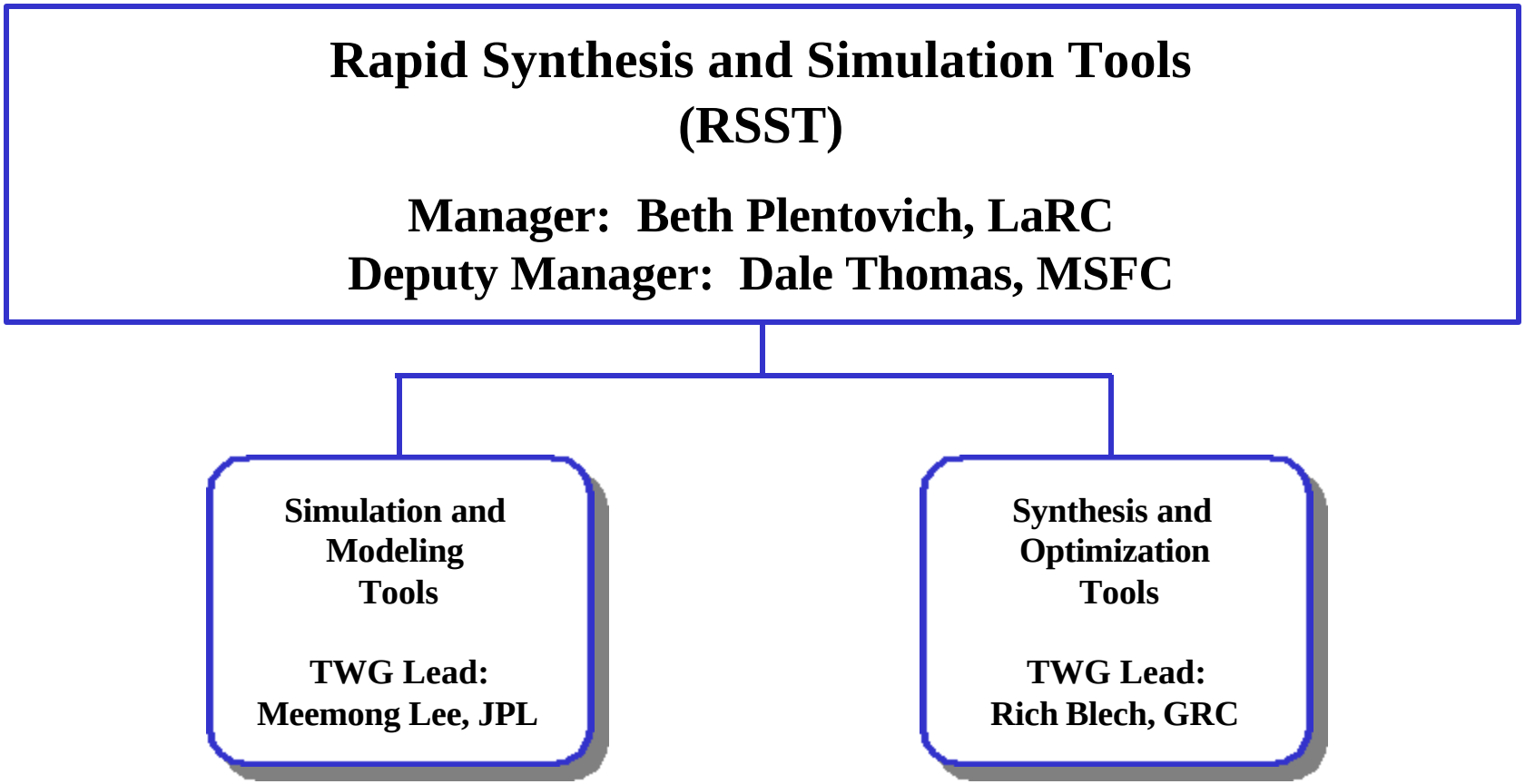
Optimization Tools

- **Description** - A process for finding the best, or a set of the best, among many options

- **Current SOA**
  - Automated optimization can be done for a single discipline
  - Optimization over multiple disciplines or parameters is a manual process

- **RSST Enabled Future Capability**
  - Enable simple level of automated optimization capability over the complete mission life cycle for a user-specified parameter set.
  - Incorporate promising advanced technologies to improve decision making capability (consider genetic algorithms, fuzzy logic, intelligent assistants)

Organization Structure



Summary

- RSST will be developing revolutionary tools for synthesis and simulation of systems over the full life cycle.
- Technology needs that RSST will address are being defined to identify topics for proposals
- RSST workshop was used and will be used to stimulate Government/Industry/Academia dialogue in all technology areas
- Collaborative engineering partnership for RSST technology will be developed